To: Jerry Meral, BDCP Director
From: The Bay Institute, Environmental Defense Fund and Contra Costa Water District
Date: December 21, 2011
Re: Review of Appendices C and D

These comments are based on an individual review and are not necessarily representative of the view of any particular non-profit organization. The commenting organizations have not had sufficient time to prepare a thorough and comprehensive review.

Because the EA analytical framework is inadequate (see previous NGO comments on Appendices A and B), susbsequent technical appendices do not (and cannot) provide answers to the most important questions facing BDCP policymakers and the general public. Results are generally compared to hypothetical "baseline" that are projected out in to the future, but they are not compared to BDCP's Biological Goals and Objectives (which remain to be developed); therefore the EA's Appendices can only be informative about change from the supposed baseline ("no jeopardy" for listed species and a relatively consistent decline for covered species that are not listed) not the plan's contribution to recovery (the legal standard for this HCP/NCCP). Equally concerning, the hypothetical baseline applied is incorrect, either because of misinterpretations of the legal baseline or because of a failure to apply the best available information (e.g. DRERIP conceptual models of covered species' life history or statistically significant relationships between flow and ecological response variables). Also, the Flow Appendix frequently responds to uncertainty regarding mechanisms (e.g. between Delta outflow and response estuarine species) as a rationale for casting doubt on the high-magnitude, persistent, cross-species, statistically significant, positive relationships between freshwater flow and estuarine species' abundances. Failure to understand the mechanisms involved does not cast doubt on the significant (i.e. non-random) relationships; rather, it calls for an interpretation of flow effects that does not foreclose any of the possible mechanisms – by contrast, the Flow Appendix presents flow data in a way that tends to minimize the potential effects of flow changes (e.g. by averaging flow in multiple months rather than addressing the maximum change expected in any month when an underlying mechanism may be operating) on covered species abundance and distribution.

<u>Evaluating BDCP outcomes by comparison to a baseline that analysis reveals will have significant negative impacts to covered species is not acceptable.</u>

A particularly important example of this problem is the EA's treatment of impacts to flow conditions (volume, temperature, DO) anticipated under global warming. The Flow Appendix routinely concludes that BDCP will produce *"... no major or consistent adverse effects*" to listed species, while simultaneously concluding that *"... changes in upstream habitat conditions [will result] from natural variation ... <u>and future climate change</u>.*" (e.g. Section C.7.2.1 *emphasis added*). Similarly, the Appendix states that: *The great majority of modeled river flow estimates upstream of the Plan Area suggested that, <u>once effects associated with climate change were factored out</u>, average differences in flow between PP and EBC during covered fish species* *migration and transport periods would be minor…"* [Section C.7.2.4, emphasis added]. The fact that the Appendix finds "major habitat effects" arising under both the supposed environmental baseline and the BDCP does not mean that BDCP's effects can be discounted because they are related to climate change. Nor can the effect of climate change be "factored out" since the Projects can be modified to mitigate this impact. The impact actually arises *from the existence and operation of the Projects* – these impacts may be exacerbated by climate changes, but they originate with the Projects. This result must be interpreted to mean that both the "status quo" facilities and operations and those proposed under BDCP may produce impacts to covered species that are legally unacceptable. The appropriate conclusion to draw from such a result is that negative impacts attributed to Project structures and operations under BDCP (whether they are related to climate change or some other source) must be *more than offset* by BDCP's biological benefits to the affected species. If the proposed BDCP alternative cannot *more than offset its negative consequences* (the comparison to a hypothetical "status quo" condition notwithstanding), then BDCP must present alternative sets of operations and facilities that do not cause unmitigated adverse impacts to the covered species.

<u>Comparison to a baseline that is based on "no jeopardy" to listed species is not sufficient to reveal BDCP's contribution to recovery of the listed species and certainly is not valuable for evaluating effects to non-listed species for which there is not an established "no jeopardy" baseline. The EA must compare projected outcomes of the BDCP to BDCP's biological Goals and SMART Objectives *and* to actual conditions that existed prior to/during the covered species' declines.</u>

In order to answer the question: *Will BDCP make a significant contribution to the recovery of the covered species?,* BDCP's projected outcomes must be compared to (1) Biological Goals, SMART Objectives and specific Stressor Reduction Targets (as described in the Logic Chain) and (2) *actual* historical flow conditions that existed when the ecosystem and covered species were more productive than they are currently. By contrast, the BDCP Flow Appendix inexplicably relies on two estimates of "baseline" Delta outflows that (a) were not designed to produce recovery, (b) have never existed (so that their biological performance could be measured), and (c) are very likely to be inadequate for maintaining (much less restoring) the covered species. We do not understand or agree with the decision to study two hypothetical "baseline" conditions, one of which includes a Fall X2 requirement and the other excludes Fall X2 as a requirement. Given that (a) the Fall X2 provision is a requirement of the current Biological Opinion and (b) agency biologists have already written that a BDCP that does not incorporate Fall X2 "may not be permitable", application of a baseline without this necessary protection is misleading and uninformative.

Because it does not compare projected results of BDCP to pre-determined targets (i.e. from the Logic Chain) and actual flow conditions that existed when populations were doing better than they are today, the Flow Appendix inappropriately dismisses potentially severe impacts. For example, the analysis finds that: "*In dry and below normal water years, the reverse OMR flows are increased compared to existing biological conditions, which may translate to adverse effects on Chinook and splittail juveniles, and Delta smelt and longfin smelt larva and juveniles."* But the Flow Appendix dismisses these potential impacts, without even describing their implications or magnitudes, stating: "*However, the reverse OMR flows under the BDCP for all water years are still within the requirements of the NMFS and USFWS BOs for CVP and SWP operations, and the biological response of these species to relatively small OMR reverse flow changes may not result in adverse changes in species survival*". The Appendix is correct to assess potential changes to OMR flows because this variable is causally and statistically related to entrainment rates (and thus biological outcomes of the Plan). It is inexplicable that, when potentially adverse effects of the Plan on this parameter are detected, the Appendix backs away from the validity of its analytical approach. Furthermore, projected reverse flows worse than current values but "within limits" set by NMFS and USFWS BiOps are not acceptable under BDCP's legal mandate because the BiOps are designed only to *prevent jeopardy to listed species* whereas the BDCP is designed to *contribute to recovery of all covered species*. Finally, the covered species include non-listed species such as longfin smelt, Sacramento splittail, white sturgeon, and others that are not addressed by the BiOp RPAs. The BiOp RPA's were not intended to protect (and certainly not to recover) these species; hence the substitution of the entirely different and weaker "no jeopardy" standard to explain away potentially negative impacts to species that are not covered by the BiOps is inappropriate and unacceptable in the context of an HCP/NCCP. The EA should not treat lightly the finding the OMR flows may be more negative in the future, especially under Dry and Critically Dry year types (when natural conditions already tend to depress covered species' populations).

In another example of an inappropriate baseline condition, the Flow Appendix assumes Delta outflows are the minimum required under D-1641. We have stated numerous times that the appropriate standard of comparison for outflows is not the hypothetical minimum level of protection provided by D-1641, but rather *actual flow conditions* that the covered species' experienced when they were in relatively good condition (e.g. pre-1987) or, at least, the actual flow conditions they experienced during their 20+ year decline. In most cases, these actual flows were greater than flows projected by modeling the D-1461 standard, and yet the species still declined. The State Water Resources Control Board, in its 2010 Public Trust flows hearings, unequivocally reached the conclusion that recent flow conditions in and through the Delta have been inadequate to maintain the public trust, including specifically BDCP's covered species. Thus, it is uninformative and misleading to employ a regulatory minimum standard (D-1641) as the baseline condition rather than the (greater, though also insufficient) actual outflows (expressed as a ratio of actual to unimpaired outflows) from a period when fish populations in this estuary were more robust. Simply put, D-1641 is an artificially low baseline for projecting future Delta outflows (especially when requirements for greater outflows in response to deteriorating estuarine conditions are foreseeable); the result that BDCP will not appreciably change flows from D-1641 requirements is actually an admission that flow conditions are likely to decline under the BDCP from what they have been since D-1641 was implemented. On the other hand, we can be certain that when BDCP projected flow conditions are worse than those anticipated under a "barely meet D-1641" scenario, they will be inadequate to protect (much less contribute to recovery of) the Delta ecosystem and its native species.

<u>Comparison of BDCP to a hypothetical, modeled baseline is not acceptable if that baseline does not account for known, foreseeable changes that will occur in the future (e.g. climate change).</u>

Change in (or addition of) appropriate baselines for comparison may necessitate changes to the modeling approach for estimating impacts to the covered species. For example, if the BDCP were only required to perform as well as some hypothetical baseline condition in protecting upstream resources, then application of the 82-year flow/temperature relationships might be appropriate -- as long as both scenarios received the same inputs, the comparative approach would still be valid. However, because it is widely acknowledged that temperatures in the region are likely to be considerably warmer over the next 50 years than they were in the 82-year record, reliance on historical temperatures found in different "*water‑year type[s] over the 82 year period of hydrologic analysis, in combination with information on instream flows ... to assess potential differences in water temperature conditions between model scenarios*." [p. C.5-18] will produce erroneous results regarding future flow and flow-temperature relationships. This historical record almost certainly underestimates the temperature related impacts of the Projects (under either status quo or PP operations and configurations) in the future. While reliance on the historical record may produce an accurate comparison of different model scenarios, it does not provide an accurate estimate of absolute impacts by the Projects in the future.

<u>The EA's assumptions regarding species life history and ecology are often incorrect and this can lead to potential bias in detecting and evaluating projected impacts. This is inexplicable given that the BDCP is supposed to base its assumptions about species life history, behavior, and ecology on accepted, peer-reviewed, and well-documented conceptual models, such as those produced for the Delta Ecosystem Restoration and Implementation Plan (DRERIP).</u>

Use of appropriate, peer-reviewed and widely accepted conceptual models of species' life history, behavior, and ecology in this ecosystem is a foundational issue. Previous versions of the EA were roundly criticized for failure to present comprehensive species' life history conceptual models or to rely on those already developed and peer-reviewed through DRERIP. The NGO community was promised that this most recent effort at an EA would make extensive use of the DRERIP conceptual models. Apparently, this is still not the case. Estimates of BDCP's impacts that are based on incorrect and undocumented assumptions about species life history are bound to be wrong. The DRERIP models represent the best estimates we have of covered species behavior in this ecosystem. Deviation from these models must be clearly documented, described, and justified.

Specific examples of inaccurate conceptual models include:

The Flow Appendix uses seasonal spawning and incubation periods for salmonids as:

- Winter run Chinook salmon: July–October
- Spring run Chinook salmon: October–January
- Fall run Chinook salmon: October–January
- Late fall–run Chinook salmon: February–May

These estimated spawning/incubation seasons are different from the spawning seasons presented by the DRERIP Life History Conceptual Model for Salmonids copied here:

Table 5. The estimated range in the time of spawning by Chinook salmon in various Central Valley rivers, summarized from tables 6-1 to 6-4 in Williams (2006). Run:	5% by	Peak	95% by
Fall	**mid-Sep. to late Oct.**	**Mid-Oct to late Nov.**	**early Nov. to late Dec.**
Late-fall	**early to late Dec.**	**late Dec. to late Jan.**	**late March to early April**
Winter	**early to mid-May**	**early June to early July**	**early to mid-August**
Spring	**late Aug. to early Sept.**	**Sept. to early Oct.**	**mid to late Oct.**

Inaccurate spawning/incubation periods and migration periods will potentially lead to mis-estimation of temperature and flow impacts to the species of concern. Fortunately, the Appendix correctly identifies potentially severe egg mortality of spring run Chinook salmon spawning in the Sacramento River during September (Section C.7.2.1), despite the fact that the Appendix mis-identifies October as the beginning of the period when eggs would be susceptible to high temperatures. On the other hand, winter run Chinook salmon eggs are potentially at risk from high temperatures as early as mid-May, and certainly during June but the Appendix does not seem to account for this risk as it incorrectly suggests that winter run spawning begins in July.

Similarly, the Flow Appendix deviates from accepted timing of fry presence in upstream habitats. Winter-run Chinook salmon emerge from the eggs starting in late-July and, whereas the bulk of these fish are expected to emigrate out of upstream habitats by mid-October, some winter-run may remain in upstream habitats into April of the following year. This estimate of migration timing differs significantly from that reported in the EA (August through December) with likely differences in the potential impacts of flow stressors on juvenile winter-run Chinook salmon. Also, whereas the stated upstream fry residence period of January-May is correct for San Joaquin fall run Chinook salmon, fall run from the Sacramento River are believed to migrate earlier in the year (December through March, with the peak in January and February; Williams 2006). Clearly, this discrepancy in the projected timing of fall run Chinook salmon could have important consequences for analyses related to upstream and floodplain habitat usage.

Furthermore, the Flow Appendix incorrectly identifies Nov-April as the period of winter-run juvenile emigration from freshwater (Table 5.3) and Oct-May as the relevant migration period for steelhead. Where is the documentation for these assumptions? Our review of the literature indicates a much longer migration period for winter-run, beginning as early as August and ending by late March of the following year. And for steelhead, we believe the juvenile migration period is mostly Jan-May and for wild (non-hatchery) steelhead, in particular, the peak migration period is from late march-May.

<u>The EA's choice of models is often flawed in important, and sometimes egregious, ways.</u>

We are glad to see that the Flow Appendix finally acknowledges some of the inadequacies of the DPM as a tool for projecting salmonid mortality under different operational scenarios. As the Appendix notes, at its best, DPM would only apply to large Chinook salmon smolts, because the studies it is based upon used only large smolts that could be fitted with acoustic tags. However, it is not clear how the Appendix deals with mortality to Chinook salmon <u>fry</u> that enter the Delta. Fry migrants represent an important life history strategy and significant component of the fall run and spring run Chinook salmon emigrants. This sizeable fraction of the population would be expected to respond differently (and probably be more susceptible) to flow alterations than Chinook salmon smolt, but the EA seems to not address flow-related impacts to this life history strategy.

Despite this modification of DPM to address our previous comments, *DPM remains a completely inappropriate tool for estimating salmonid mortality (or even relative mortality across scenarios) in the Delt*a. First, even if we limit the conclusions drawn to inform us about the behavior of salmon smolt only, DPM is built upon an extremely non-representative sample of fish (either hatchery reared late-fall run or hatchery-reared steelhead) that would not be expected to behave like the winter-run Chinook or spring-run Chinook--the primary foci of this analysis. Second, each of these studies was conducted in only a few weeks during the late-fall and winter of just a few study years –releases conducted during the same water year cannot be considered statistically independent samples as conditions (predator position and density, flow rates, temperatures, turbidity) are highly spatio-temporally autocorrelated. Such small sample sizes (usually two somewhat independent data points) cannot be used for statistical inferences within, much less beyond, the season studied (e.g. into late-winter and early spring) or in water year types more extreme than those in which the foundational tracking studies were conducted. Regardless of the quality of the studies (which we are not commenting on here), there is simply no data on which to base projections of spring-run Chinook salmon (their migration season was not studied) or any salmon migrating during dry or critically dry years (studies that form the basis of DPM were not conducted in those year types). Given the known differences in behavior between hatchery and wild fish, it is valid to question whether the studies that DPM is based upon can serve as proxy for any wild fish; but, that issue aside, no reasonable statistical analysis or quantitative estimate of uncertainty can be based on three observations (the maximum number of years (samples) for which data was collected in any of the studies upon which DPM is based).

We concur with the EA that impacts of Project operations to longfin smelt and other estuarine species are largely related to Project impacts to Delta outflow. The magnitude, significance, and persistence of the statistical relationship between outflow and longfin smelt abundance (Jassby et al 1995; Kimmerer 2002; Rosenfield and Baxter 2007; Sommer et al. 2007; Kimmerer et al

2009; McNally et al 2010, etc.) is beyond question. Furthermore, our analyses (TBI et al. 2010, exhibit B) strongly suggest that that high outflows correspond with periods of LFS population growth, even after the introduction of invasive *Corbula* clams in the late 1980's – this analysis and others we presented to the SWRCB 2010 Public Trust Flow hearings should be incorporated into the A's analyses of flow-related impacts.

The Flow Appendix presents the flow-abundance relationships for the longfin smelt population in this Estuary in a way that will tend to lead to underestimation of potential impacts to this species. In particular, the Appendix calculates the relationship between longfin smelt abundance and average December-May Delta outflow. (This seasonal period is incorrectly attributed to Kimmerer 2002 and Kimmerer et al. 2009). In fact, several seasonal averaging periods have been used in the study of relationships between flow and abundance for longfin smelt. These averaging periods were chosen to reflect different critical periods in the species life history: Rosenfield and Baxter (2007) studied flows during the peak spawning and incubation period (from January-March) on subsequent LFS abundance; Kimmerer 2002 studied the period of peak larval transport (March-May); and Jassby et al. (1995) studied flows in the period March-June, when larvae are transported and metamorphose into free swimming sub-adults. Even within these studies, flows were averaged across months in order to capture potential effects that might occur *at any point within that time frame* not necessarily because the average flow over a multi-month period was actually the variable thought to be driving the response (i.e. average flows during March-May are used as metric of flow during all periods March-May, any or all of which were believed to be potentially important).

As the Appendix points out, the mechanism behind the flow-abundance relationships are not well understood. Thus, it is possible that flows affect longfin smelt abundance at any (or several) period(s) within those seasons where the flow-abundance relationship has been established. It is even possible (and likely) that flow benefits LFS populations in more than one life history stage in the winter and spring and that different life history stages are impacted by different flow-mediated mechanisms. By calculating impacts to longfin smelt based on flows averaged from December through May, the EA (a) ignores the potential effects of freshwater flows in June as documented in the relationships described by Jassby et al (1995) and, more importantly, (b) tends to minimize the impact of flow variations expected to occur under the BDCP – minimizing variation is, after all, what averaging accomplishes[1]. Rather than projecting impacts to LFS populations from *average* December-May flows, the Flow Appendix should project flows in each month from December through June *separately* and then asses the impact of that flow change as if the entire flow-abundance relationship were explained by a mechanism operating in that month. If there is a causal relationship between flow and longfin smelt abundance (and all evidence strongly suggests that such a relationship persists today) but there is no way to know exactly when flow has its biggest impact on longfin smelt abundance, then the conservative

[1] To illustrate this mistake, consider the appropriate approach to measuring water temperature impacts to salmon eggs. Clearly, these eggs are sensitive to temperatures on a particular day or maybe even over the course of several hours. Monthly average water temperature is a relatively poor surrogate for the variable of importance (hourly or daily water temperatures) and would tend to underestimate the frequency of temperature impacts on eggs. Similarly, semi-annual average flow is an incredibly coarse tool for measuring the impact of flow variations that may act on much, much finer time-scale (e.g. months, weeks, or days).

approach to estimating impacts would be to base such an assessment on the month(s) with the greatest change in flow, not on an average change in flow over more than half the year.

For example, if the average change in flow between December and May under BDCP is X%, then the average change in flow for some (approximately half) of the months between December and May will be *greater than X%* under BDCP. Because it is possible (and even likely) that the impact to longfin smelt will be a result of the greatest deviation in flow (not the average deviation over a six month period) between scenarios, the true impact to longfin smelt is better (and more conservatively) estimated by the period of greatest flow deviation between the scenarios.

We note also that the EA downplays the likelihood of the flow-abundance relationships because the particular mechanism(s) by which Delta outflow affect longfin smelt populations is unknown. Numerous candidate mechanisms are proposed by Kimmerer 2002b. However, for purposes of management and estimation of impacts potentially related to the BDCP, the mechanism by which flow benefits longfin smelt is not highly relevant. The known relationships between outflow and abundance are not at all likely to occur at random (that is the meaning of their statistical significance); so, whatever mechanism(s) are involved, they produce the flow-abundance relationship. It is also worth noting that almost every analysis performed in this EA (including the hydrodynamic modeling) is based on statistical correlations for which the root mechanisms are unknown at some level. It is misleading and unacceptable that the EA should back away from its own analyses under the "mechanism unknown" cover when the analyses show negative impacts of the BDCP, while not raising this concern when modeling projects a more beneficial outcome[2].

<u>Appendix C fails to address the central role of freshwater flow in driving riverine and estuarine food web productivity.</u>

As it hedges on a flow-mediated transport mechanism driving the flow-longfin smelt abundance relationships, Appendix C suggests an alternate or complimentary mechanism driving LFS abundance -- food production; so it is curious that the Appendix does not study or mention the well-established relationship between Delta outflow and probable LFS food items (e.g. *Eurytemora, Crangon* shrimp, etc). The failure to address the relationship between zooplankton production and Delta outflow is striking given that much of the BDCP's conservation strategy for all covered species hinges on production of zooplankton. The reduction in Delta outflows projected in the EA would be expected to reduce production of these essential zooplankton species and it is remarkable that this effect is not accounted for in the EA. We expect that the analysis of food production in this ecosystem (in whichever EA Appendix that occurs) will account for the impact of fresh water flow alterations on zooplankton production in much the

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[2] It is baffling that the Flow Appendix undermines its own analysis of Flow-Abundance relationships for longfin smelt, which are based on statistically significant correlations whose slopes have not changed over the last 40 years, yet it constructs an incredibly complicated analysis of all salmonids in this system (the "Delta Passage Model") based on correlations between flow and migration path present in data from 1-3 years of study of non-representative hatchery fish.

same way as it has done for the relationship between fresh water flow-LFS abundance relationships.

Similarly, the Flow Appendix seems to ignore the relationship between food production and flow rates on both rivers and floodplains in this system. In its analysis of BDCP's effect on floodplains, the Flow Appendix employs depth as the only measure of habitat suitability on the floodplain. Research on the Yolo Bypass indicates that flow rate on the inundated floodplain also has a profound effect on food production and the growth and survival of covered fish species (T. Sommer *pers. comm.*). Other studies demonstrate important effects of flow rate on food production in river channels and other floodplains (e.g. the Consumes) of the Delta; analyses and results of these and other studies must be incorporated into the Flow Appendix if BDCP is to evaluate the effect of alternative projects on food production in various regions of the Estuary.

<u>Because there is no specific adaptive management (A.M.) strategy that is connected to BDCP governance, there can be no assurance that environmental conditions will improve under BDCP.</u>

There are two related problems here:

- There is no A.M. strategy to monitor and adjust anticipated/unanticipated impacts, and
- A.M. is not "baked in" to the EA and conservation strategy, as it *must* be in order for A.M. to work.

Both of these problems represent long standing critiques of BDCP by the NGO and scientific communities. Each can be solved by fully implementing a Logic Chain approach to BDCP planning (as the NGO community has advocated numerous times); but the current draft appendices fail to implement such an approach.

<u>On the whole, the Flow Appendix fails to link its high-powered modeling analyses with conclusions of interest to BDCP decision makers; this stems from the failure of the EA to identify, in advance, key questions whose answers would enable evaluation of the proposal.</u>

In many places, it is difficult or impossible for the reader to follow the logical progression from raw data outputs to conclusions drawn in the Flow Appendix. The Flow Appendix provides inadequate linkage between highly detailed modeling outputs, such as those included in Section C.6.2, and the conclusions presented in Section C.7. The former are far too detailed to be in the main body of this chapter; the myriad graphs and tables present nearly raw data without any valuable synthesis of the data that would allow the reader to identify key features of the modeling outputs. By contrast, the conclusions in section C.7 lack any reference to specific findings of the modeling -- they read as simple assertions. The omission of what we suspect are key tables that summarize the results (Table C.1 3; Table C.1 3; Table C.1 4; and Table C.1 5) is particularly unfortunate and impedes a thorough review of the draft.

As a result of this failure to link together data outputs with conclusions, it is not possible for the reader to evaluate the risks or potential benefits of BDCP. For example, we have commented before that the projected changes in freshwater flows on the American and Feather Rivers between months (within a given year) appear to be greater under the BDCP than are permitted now. Large changes in fresh water flow from one month to the next may result in the dewatering of salmon and/or steelhead redds if flows are high at the beginning of the spawning period and subsequently drop, exposing redds. An interested reader would need to go beyond the material presented in the EA to determine whether this risk is substantial and how frequently dewatering of redds in these tributaries may occur under projected BDCP operations. The potential for increased impacts of redd dewatering on Sacramento River tributaries must be assessed thoroughly and transparently.

<u>Important Details:</u>

1) The time periods (ELT, LLT) all include year 15 of the project. This gives double weight to the particular modeling results of year 15.
2) Winter-run Chinook salmon spawn and migrate to/from the Sacramento River, not the San Joaquin River, thus, the references to winter-run migrating through the Stockton Deepwater Ship Channel are erroneous.

<u>In addition to the comments above, the following are comments regarding the limitations in the modeling tools and flaws in the analysis from the use of these tools.</u>

1. Limitations of Modeling Tools

The modeling tools that simulate statewide operational changes for the SWP and CVP (CALSIM II) and hydrodynamics and transport within the Delta (DSM2) have known limitations in forecasting water supply and water quality conditions in the current configuration of the Delta. These same model tools have undergone numerous changes by the BDCP project team to implement the new OCAP BiOps under current conditions and to forecast conditions in a radically altered Delta. The models, including the recent modifications, need to be fully documented and validated and should undergo a peer review.

Results in BDCP technical appendices attachment C.A (CALSIM and DSM2 Results) indicate possible problems in the modeling tools. For instance, Figure C.A-46 shows a timeseries of monthly salinity at Old River at Rock Slough, which is a location where the CVP and SWP must meet specified water quality standards. At this location, electrical conductivity (EC) should not exceed about 1,050 uS/cm on any given day. The models are "trained" to modify operations to meet this standard, although the training is never perfect and generally a few exceedences are found in planning model runs. However, the BDCP runs show far more frequent and extreme exceedences than has been commonly observed in previous planning studies. The simulated values in Figure C.A-46 show that the limit is exceeded on a monthly average during approximately half of the years, even in the base case (EBC). Since this does not happen in reality, the ability of the models to simulate actual conditions and produce results that can be used to evaluate project alternatives is in question. The above is just one example of possible problems with the modeling tools.

Further, as designed, CALSIM II simulates the operation of the State Water Project and Central Valley Project systems in their most recent configurations and according to the most realistic characterizations of current operating criteria. Delta operations in the future are likely to be affected by other system changes not presently considered by CALSIM studies. Also, while

CALSIM II is an important tool for analysis of water supply reliability, it does not account for other supplies and opportunities that occur outside the SWP-CVP system.
The Bay-Delta Conservation Plan analysis of alternative water operations criteria must extend beyond CALSIM modeling studies with current state and federal sharing formulae and existing south-of-Delta water storage capacity. Failure to anticipate changes in water management, both within and beyond the Central Valley Project and the State Water Project, will result in faulty analysis and unwarranted costs of water scarcity.

The BDCP must make every attempt to address the following water management elements within and beyond use of the CALSIM model. These elements, alone and in combination, will significantly affect how water users respond over the lifetime of the Bay-Delta Conservation Plan and thus necessitate incorporation in the Effects Analysis and EIR/EIS.

A. <u>BDCP analysis must anticipate increases in south-of-Delta storage.</u> While additional storage is not part of the BDCP, it is likely that water districts and others will continue to invest in south of Delta storage in future. As a result, there will be fewer and fewer instances in which CALSIM model results project that export pumps would be idle at times when large flows are available because there is "no demand". In 1994 when the Bay-Delta Accord was modeled using DWRSIM (the predecessor to CALSIM), non-project investments such as Eastside Reservoir, the Kern Water Bank and the Semitropic Water bank had not been made. As a result of these investments, it is now possible to move more water at different times of the year under any specified set of operating criteria. Investments in south-of-delta storage are likely to continue and must be incorporated in BDCP analysis.

B. <u>BDCP analysis must anticipate changes in CVP and SWP policies.</u> Current policies for operations of the CVP and SWP are guided by the 1986 Coordinated Operations Agreement. The COA at times limits project exports, beyond what is required by protective operating criteria, by assigning to the State Water Project and to the Central Valley Project certain separate rights to export and responsibilities for providing in-Delta flows. Changes to the COA would be consistent with other recent policy changes that have accommodated increased deliveries to contractors and their aforementioned non-project storage facilities. The CVP now allows contractors to bank water from one year to the next in san Luis Reservoir when there is space. The State Water Project has greatly increased the frequency and volume of unscheduled (Article 21) exports to its contractors. Modeling studies that do not anticipate changes to the COA and other sharing formulae may well under predict the volume of exports that is possible and thus overestimate the costs associated with water scarcity.

C. <u>BDCP analysis must anticipate water transfers from the Sacramento Valley.</u> Over the last few decades, additional supplies from the Sacramento Valley have been purchased by south–of Delta interests. Such purchases are difficult under the current operating guidelines since Old and Middle River flow criteria control Delta operations during much of the year. Analysis of operations with a north of Delta diversion point would effectively circumvent the Old and Middle River flow criteria and allow very large increases in exports. If the BDCP intends to permit these water transfers, they must be incorporated in the analysis. If the BDCP intends to preclude such transfers, it must do so clearly. Either way, the potential for increased water transfers must be addressed.

D. BDCP analysis must anticipate increases in water transfer activity in export areas. South of Delta water transfer activity is extensive, especially in dry years when productive west-side districts receive small allocations of maximum Central Valley Project entitlement. These contractors have purchased supplies from others who have larger contractual allocations and/or more access to additional supplies including managed groundwater storage projects. The importance of water transfers in relieving the costs of water scarcity was recently underscored in "A Retrospective Estimate of the Economic Impacts of Reduced Water Supplies to the San Joaquin Valley in 2009" (Howitt, Michael et al.). In addition most analysis by the Public Policy of California anticipates more "fluid" south of Delta water markets. The BDCP must as well.

E. BDCP analysis must integrate other district supplies. Most Delta exporters have significant water supplies in addition to what they export from the Delta on an annual basis. They have the ability to manage groundwater, local storage and other supplies to balance the inter-annual variability associated with Delta exports. BDCP analysis must integrate these additional supplies, anticipating the rational economic responses that export contractors will make over time. The BDCP need not delve into detailed integrated resource planning in the export areas but should consider alternative water supplies, including but not limited to water recycling, stormwater capture, improved irrigation technology etc., in both the urban and agricultural sectors, from a cost-effectiveness perspective.

The following are other problems with documentation, benchmarking and accessibility from the use of CALSIM II. These and other concerns were raised more than 10 years ago, without response from the Department of Water Resources of the Bureau of Reclamation. See attached "Comments on CALSIM II" from the Environmental Defense Fund, September 14, 2001.

- While CALSIM II has been accepted as the model for analyzing alternative CVP and SWP operations for over 10 years, basic steps have never been taken to ensure confidence that the model simulations are reasonably accurate. CALSIM has never been benchmarked. It is common for simulation models to show they are capable of reproducing actual operations. This basic has never been undertaken with CALSIM or its predecessors.

- CALSIM is a model that is very difficult to use – in fact more difficult in fact than its predecessors, DWRSIM (for the SWP) and PROSIM (for the CVP). It does not have a usable help feature and can be used only by relatively few individuals who must devote significant resources to learning the model. It is not publicly accessible from a practical perspective.
- CALSIM has limited documentation, including no description of the geographic nodes in its network. There is no description of what laws and regulations control flows or what institutions divert water. The limited documentation that is available on the internet is more than ten years old. (See http://baydeltaoffice.water.ca.gov/modeling/hydrology/CalSim/Documentation/index.cfm)
- CALSIM does not have the capability to consider reservoir storage criteria as an objective in order to preserve cold water pursuant to legal requirements or other objectives to protect endangered salmon. CALSIM is designed to first meet environmental flow requirements and then to deliver as much water to South of Delta contractors as possible according to a risk curve that balances deliveries with water supply. The lack of ability to include storage targets as objectives is a serious deficiency as temperature requirements often control system operations.

While we believe the modeling tools should be corrected and validated prior to comparison between alternatives, we offer the discussion below of the analysis of the model results to highlight areas that are incomplete or incorrect.

2. Deficiencies in the Analysis

Much of the discussion of analysis in appendices C and D lacks fundamental evaluation of Delta hydrodynamics, which affects the transport and transformation of many of the constituents that are discussed, but not properly analyzed. Outstanding omissions in the analysis include the following:

- Residence Time (Appendix C)
    - Residence time is presented for a limited number of time periods of the model simulation period to represent a variety of hydrologic conditions. Residence time in the Delta changes drastically in response to hydrology and operations. Changes in residence time would be expected to alter primary productivity, pH, and temperature, and thus alter transformations of constituents. However, the appendices do not appear to analyze the effect of changed residence time but rather draw a conclusion based on the average change in residence time over all time periods. Average change is not relevant to any processes and thus not important to any covered species. This analysis should be expanded and the results should be integrated into other areas of Appendices C and D.
    - The particle tracking model as used in this analysis likely underestimates residence time because particles are removed from the system when they are diverted by agricultural intakes within the Delta (reducing residence time). Many constituents are not consumed by agriculture, so when the water is discharged

back to Delta channels, the constituents return to Delta channels, concentrated by consumptive use. The analysis should be modified to properly account for the true residence time in the system or the discussion should be expanded to disclose the limitations and biases of the models.

- Turbidity (Appendix C)
  - Sediment load entering Delta from the Sacramento will be reduced, as a portion of the load will be diverted at the proposed north Delta intakes. Quantity, timing, and effects of this reduction on turbidity in specific regions of the Delta should be evaluated.
  - Reduced south Delta exports will reduce the amount of suspended sediment from the Sacramento River to enter the south Delta. These effects on turbidity in the central and south Delta should be similarly quantified and evaluated.
  - Barriers in the south Delta affect the transport and erosion/deposition of sediment from the San Joaquin River. The appendices indicate that barrier operations will be different under the PP. Quantification and evaluation of effects on turbidity is needed.

- Appendix D (Toxins) lacks proper analysis of the transport and transformations of the constituents, and makes statements that are contradictory to the hydrodynamic results presented in Appendix C (Flow). For all constituents, the toxins appendix needs to be reworked to integrate the results of flows and residence time into the analysis. The following are just a few examples of inconsistencies or incomplete analysis:

  - Selenium:
    - Selenium background section (D.5.2.1) recognizes that longer residence time results in higher selenium concentrations in wetlands and shallows. Appendix C illustrates that residence time can more than double, increasing more than 20 days at times. Yet the analysis does not consider this increase in residence time.
    - Discussion of bioaccumulation and biomagnifications of selenium is incomplete, only referencing a model that is not discussed (section D.5.2.2.3). Does the model incorporate residence time, bioaccumulation in *C. fluminea* in the south Delta (not mentioned anywhere in the Appendix D), or the effect of restoration area on the food web and possible biomagnification?
    - Implementation of the basin plan objective for selenium has been delayed in the past. Analysis of the effect of water operations should disclose the effect of the PP without assuming actions by third parties.

  - Ammonia: Diverting water from the Sacramento River will decrease the dilution flow for ammonia discharged from the Sacramento WWTP. The appendix must analyze the effect of this reduced dilution. The current analysis assumes that the reduced dilution is not a factor because the WWTP has new requirements to reduce their discharge. However, the requirements are currently under appeal and may not be implemented as written. Therefore, it is unreasonable to assume that these requirements are in effect and will be in effect in the future. As such, the appendix should analyze the effect of reduced dilution in the event the WWTP does not implement the ammonia requirements as currently written. .

- Mercury: discussion of the effect of water operations is incomplete citing lack of data, yet there is also mention of a model that is not described. Methylation of mercury in California Delta water and sediments is a known concern, and project effects on this constituent should be evaluated.

Additional problems with the analysis include:

- Model accuracy:

  In February 2009, project operations found that there was insufficient water supply in project reservoirs to meet both Delta outflow requirements in the spring and cold water releases later in the year. While 2009 was indeed the third consecutive dry year, its hydrology was well within conditions considered by prior CALSIM studies which showed both objectives could be met. Instead project operations deviated from modeling simulations. See attached Environmental Defense Fund testimony to the State Water Resources Control Board, with its (unanswered) request that the SWRCB require the CVP and SWP to submit plans that show required protective operating criteria can always be met. If modeling studies are to characterize that multiple environmental objectives can be met, operating criteria should adhere to the same principles as the operating criteria.

- Hydrologic conditions considered in modeling studies:

  Appendix C makes note of different hydrologic conditions considered under “existing conditions”, “early long-term” and “late long-term”. There is also such mention in Appendix A. But neither appendix provides quantitative description of the assumptions in question, though these different assumptions clearly have significant effects on biological resources and the system’s ability to export water.

  The role that hydrology, operational criteria and infrastructure play in affecting biological protection may be easier for many to understand if displayed in a matrix form as shown below (the example is in terms of annual average exports but the form could be used for any variable).

Average Annual Delta Exports
thousands of acre-feet

	Current Operating Criteria (without fall x2)	Current Operating Criteria (with fall x2)	Proposed Project	Export Increase under Proposed Project
Existing Conditions	5144	4898		
Early Long Term		4728	5913	1185
Late Long Term		4441	5456	1015

- Carryover Storage:

  - Shasta storage - the modeling shows markedly decreased end-of-year storage in Shasta Reservoir under the proposed project late long-term scenario. Since temperature is such an important part of upstream operations there should not be significant changes or reductions in carryover storage at major reservoirs, especially Shasta. The BDCP should adopt criteria to carefully manage water temperature through carryover storage criteria. It is unclear what is driving this result – whether it is a byproduct of CALSIM's inability to require storage carryover as an input or whether the modeling intentionally (though perhaps erroneously) allows the drawdown.

  - Trinity storage – the modeling also shows additional drawdowns of Trinity Reservoir that would affect that river's Coho and Chinook salmon populations at well as its steelhead. Implementation of the proposed project should not be impairing water temperature on the Trinity River. This is a matter of policy that the Bay-Delta Conservation Plan must make clear.

- Trinity River and other biological resources interconnected with the CVP and SWP system:

  The aforementioned concern related to Trinity River storage raises policy concerns related to other aspects of Trinity River restoration as well as San Joaquin River restoration and other programs. Implementation of the BDCP must not be allowed to have negative effects elsewhere. For the Trinity River, this means temperature (as explained above), flow and funding for restoration projects and monitoring.

Commit to protection of these other environmental resources must be a cornerstone of the Bay-Delta Conservation Plan and must be incorporated in all levels of BDCP policy and analysis.